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ABSTRACT

In 1969, the author proposed that a teaching team should consist of a horizontally differentiated staff with team members trained in four distinct skill areas: 1) instructional design, 2) instructional interaction, 3) interpersonal design, and 4) interpersonal interaction. The present paper proposes, in addition, a vertically differentiated staff for the new profession of instructional design. There would be three levels: 1) instructional technicians (teacher level), with teachers trained to use instructional design guides and challenged to design and plan effective instructional environments, utilizing the materials which they have been given; 2) instructional technologists (engineering level), with M.A. level on specialist level technologists trained to develop self-contained instructional systems (multi-media presentations, programmed materials, CAI, etc.) and instructional design guides for use by teachers in preparing their own instructional materials; and 3) instructional psychologists (scientist level), with Ph.D.'s trained to specify and develop instructional theory and to conduct laboratory behavioral science research on principles of instruction. (MBM)

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INSTRUCTIONAL RESEARCH AND DEVELOPMENT

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THREE LEVELS OF INSTRUCTIONAL DESIGN[1]

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In a paper presented at the American Educational Research Association in Los Angeles, (February, 1969), I indicated that a school could be thought to contain two types of special environments; first, an inter-personal environment and second, an instructional environment. In addition to these two types of environment, it is possible to identify two different types of teacher skills. First, interaction skills, in which a teacher interacts with a single child or a group of children; and second, planning or design skills, in which a teacher structures such an interaction to bring about some specified objective. Combining these two types of skills and two types of environments, one can identify four different kinds of instructional abilities. First, instructional interaction; second, instructional design; third, inter-personal interaction; and fourth, inter-personal design.

It was proposed in that paper that rather than training teachers who are "jacks-of-all-trade," it would perhaps be to some advantage to train specialists in each of these skill areas. The result would be a horizontal

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[1]This paper was presented as part of a symposium titled, "Patterns of Adaptation to Individual Differences in Teacher Education," presented at the American Educational Research Association, February, 1971, in New York City.

teaching team with each teacher trained in one of the design or interaction areas and that this horizontal team could then plan together and work with one another in presenting instruction to the student. Team teaching is not new; but most teams that have been proposed in the past are vertical teams, consisting of a master teacher, who is a generalist, an apprentice or intern teacher, who is trying to become a generalist, and teacher aids, clerical help, etc. The proposed horizontal staffing would mean that each of the teachers were trained in an area of specialization and that rather than a vertical organization, the teachers would be comparable to one another but with different areas of teaching skills. I do not wish in this paper to detail that which was said previously; that paper will be published in The Educational Forum sometime this year.

VERTICAL DIFFERENTIATED STAFFING IN INSTRUCTIONAL DESIGN

In this paper, I would like to concentrate on one of the areas previously identified, that is, instructional design. Glaser (1965) predicted that during the next decade a new profession called educational or instructional design would develop. I would like to suggest that within this new profession there are at least three levels of skills. This paper describes the function of each of these levels and some suggested procedures for training such a vertical staff.

Francis Mechner (1965) identified five levels of performance in regard to science. These are (1) the consumer of science, (2) the skilled worker, (3) the technician, (4) the technologist, and (5) the scientist. For our discussion, the consumer of instructional design skills is the student. The

skilled worker includes clerical and media production staff and other skilled occupations which support the instructional design effort. This paper describes the function and training for the technician role, the technologist role, and the science role in instructional design.

Level One: Instructional Technicians (Teacher Level)

In a previous article (Merrill, 1968), it was suggested that there was some debate as to whether teachers operated most effectively at the technician or technologist level. After several years of working in teacher education programs, I have observed that most teachers do in fact operate as technicians, not as technologists. For them, this is perhaps the most satisfying and desirable role, especially if a new technology and science of instructional psychology successfully evolves.

In most school systems, teachers are given some type of objectives, text books, curriculum guides, and other instructional materials to assist them in their training program. In spite of all of these materials, most teachers still find that a design task exists. Most of these materials can be re-structured or presented in such a way that increased effectiveness can result. A teacher technician has the challenge to design and plan effective instructional environments, utilizing the materials which they have been given.

According to Mechner's definition, the technician carries on routine processes; that is, they are trained to effectively use specific procedures that have been developed by technologists or scientists. For example,

medical technicians carry out laboratory tests, set up equipment, etc. Computer Science technicians write programs, operate computers, etc. Routine procedures in the area of instructional design consist of teachers following step by step procedures in a cookbook like way. These procedures are designed so that when they are followed, effective instructional design is the result. For lack of a better term, we will call such materials "instructional design guides." An analogy is that of a "jig," frequently used in skilled areas. When a craftsman is faced with the challenge of turning out a large number of similar parts, he frequently does this by constructing some "jig" or form that guides his tool so that the parts produced are almost identical. In a similar way, an instructional design guide directs the planning of the teacher in such a way that the product which results has some known instructional characteristics. Because of previous developmental and validation testing of the instructional design guide, the instructional outcome resulting from its use can be predicted with a high level of probability. It is not necessary for the teacher technician to know why a particular step is included in the instructional design guide. His job is to learn to use the guide effectively, to follow the procedures accurately. The development of instructional design guides is the role of the instructional technologist and not the teacher-technician. Teacher technicians need not concern themselves with the underlying theory, rationale, or the empirical data on which the guide is based, but merely need to be trained in its effective use.

Level Two: Instructional Technologists (Engineering Level)

Mechner defines a technologist as an engineer who applies scientific knowledge to the solutions of practical problems. The instructional technologist has two distinct roles. The first, is the development of self-contained instructional systems. These would include all types of multi-media presentations, programed materials, CAI, etc. The second role would be the development of instructional design guides for use by teacher technicians in the designing of instructional materials.

Self-contained instructional systems have been described in great detail in many other publications. (Merrill, 1971; Glaser, 1965; Lange, 1966; Educational Technology Magazine; etc.) There are currently several R&D Centers and Regional Laboratories who are involved in the development of instructional systems. Persons directing this development are in most cases instructional technologists.

Briefly reviewed, the skills of an instructional technologist include; first, identifying and specifying behaviorally-stated instructional objectives; second, skill in designing and preparing criterion-referenced pre- post- and enabling-evaluation instruments; third, skill in behavioral task analysis and arranging instructional sequences. Fourth, he must be able to design and develop effective instructional materials in a variety of modes and format. Fifth, he must have some skill at designing multi-media instructional systems. Sixth, he must be able to conduct developmental testing of materials under preparation. Seventh, he must have

research skills necessary for conducting field tests or validation studies of the instructional systems.

Instructional design guides for teacher designed instruction are a relatively new idea and have not been widely applied in the training of teacher technicians at this point in time. To be effective, an instructional design guide must be very task-oriented. The teacher technician must be trained in very specific skills. It does not involve training in such broad-based goals as understanding the child, knowing the basic principles of learning and other foundation knowledge that is typical of most education courses.

Perhaps the best way to illustrate our meaning of an instructional design guide is to describe very briefly an example or two. One example currently being used in our own operation at Brigham Young University is a structured tutoring system developed by Dr. Grant V. Harrison. In this model, very specific tutoring skills are identified and materials are prepared to help train tutors in these skills. Teachers are trained with a very extensive guidebook which helps them to set up tutor training sessions, helps them to develop evaluation instruments which measure the effectiveness of the training of tutors, and helps them to measure the effectiveness of the tutor in working with the individual children. Unlike many previous tutoring systems, this system is very specific and teachers are frequently helped to train tutors in a specific skill area. The task for the teacher is to identify the specific skills to be taught, but the structure of how the tutor interacts with the student, and the structure of how the teacher interacts

with the tutor are all spelled out in considerable detail. The training objective for the teacher consists of helping them to effectively use the guide.

A second instructional design guide currently in preparation in the Instructional Research and Development Department at Brigham Young University is a design guide for concept instruction. This guide consists of several parts.

Part one is an instruction to concepts and guidelines as to what type of instructional situations are appropriate for the use of the guide. The teacher is given a number of different kinds of situations and taught to discriminate when the guide is appropriate and when it is not.

Part two then presents a teacher-technician some objectives which do not specify the particular concept to be learned but which do specify the critical conditions and behavior required for concept learning. The teacher's task is to learn how to specify the given concept which he wishes to teach and to complete the already specified objectives.

Having completed this step in the instructional design process, the teacher, in part three, is given a choice of test item types. Again, the test items themselves are written with the specific concept unspecified. The teacher is trained to fill in appropriate instances in the test items and to organize them onto an evaluation instrument.

Having completed these steps, the teacher is then given a set of guidelines for selecting examples and non-examples to be used in instruction.

The procedures for presenting these examples and non-examples to the student are very carefully specified. The procedures which are employed are empirically based. They enable the teacher to gather data on possible examples. The guide directs the interpretation of this data without statistical manipulations. The results are used in the selection of the examples and non-examples to be used in the program.

The final section of this instructional design guide helps the teacher to gather validation data after he is using the instructional materials. This enables the teacher to validate his own instruction. Instructional technologists who are developing this guide are using it in many different subject situations to train teacher-technicians. In addition to gathering data on the effectiveness of the guide, basic research has already been conducted to investigate the instructional procedures contained in the guide and has demonstrated their effectiveness in teaching concepts.

Briefly summarized, the development of instructional design guides is a primary function of instructional technologists. This development should be based on instructional theory. The guide should be empirically tested as is any other instructional system. The guide should provide some kind of teacher choice of content and specific materials and yet should be specific enough that it controls the instructional procedures used. In a sense, instructional design guides are cookbooks. If the procedures are carefully followed, teacher technicians can produce effective instructional products. It is important to note that in the

development of instructional design guides, the instructional technologist must be concerned with two levels of instruction; first, the effectiveness of the techniques specified in the particular guide for the instruction for the learners, and second, the effectiveness of the instruction in teaching teacher-technicians to use the instructional design guide.

Level Three: Instructional Psychologist (Scientist Level)

Mechner (1965) described the scientist as the producer of science. His function is the identification of problems, formulation of these problems in a manner that makes them suceptable to the scientific approach, and the solution of these problems. In the area of instructional design an instructional psychologist probably has two primary roles; first, the development of instructional theory or sets of empirical principles which can guide instructional development, and second, the experimental validation of these principles. A great deal of the instructional development currently underway in this country is being conducted by instructional technologists (level two) who operate on a "raw empiricism basis." That is, using the best folklore available, instructional materials are designed. They are then tried out with a population of students representing those for whom the materials are intended. Based on this try-out, the materials are revised, tried-out again, revised, etc. This cycle is repeated until such time as funds are expended or the materials effectively teach the population for which they are intended. Anyone involved in intensive instructional development will verify the extreme

cost of such a procedure. There is a great need for the development of a body of principles to guide the instructional development effort. Through the careful application of behavioral science methods, it is possible to study instruction as a phenomena and to develop principles of instruction which can guide this development effort. Instructional principles can be contrasted with principles of learning psychology in that the learning psychologist is primarily concerned with how learning takes place—what are the minimal conditions required for learning, what happens in the organism when the organism learns. On the other hand, the instructional psychologist is primarily concerned with the question, "How can instruction be made maximally effective and efficient?" "How can the instructional designer manipulate the environment in such a way to produce specified learning outcomes?" and "How can this be done with a minimum amount of time in a way that produces maximum retention, transfer, and accuracy?" While these two concerns are closely related, they do differ in the approach and type of problems looked at. There has been limited research and limited development in the area of instructional theory and a great deal more needs to be done. A primary function of an instructional psychologist at the science level is the development of such theory.

The methodology required for the laboratory study of such principles does not differ a great deal from behavioral science research in other fields. However, the questions asked and the variables manipulated

differ somewhat from basic learning research or other types of behavioral sciences research. Perhaps the best example from our laboratory of type of research involved is Tennyson, Woolley, & Merrill (1971).

TRAINING OF A VERTICAL INSTRUCTIONAL DESIGN STAFF

Instructional Technicians (Teacher Level)

It is our feeling, at the present, that the training of teacher-technicians can be accomplished in the same amount of time or less, than that which is now being used to train teachers. Please remember, however, the distinctions made in the first paragraph of this paper; that is, there are at least four types of teaching skills and what we are talking about here are only skills of instructional design. The ideas expressed previously about the desirability of a horizontally staffed team are still very valid in my opinion. It is a mistake to attempt, in a four year period, to train teachers both in subject matter and all four types of teacher skills. Almost nothing is being done currently to train teachers in instructional design. It seems to me that specialists who are teacher-technicians with instructional design skills, who have been taught to use a variety of instructional design guides, is perhaps one of the effective ways to meet some of the instructional needs in the public schools and other development institutions. The type of training required for an instructional teacher-technician is somewhat different from

that typically given to teachers in education programs. Rather than an extensive amount of training in foundations skills with the attendant inadequacy of this training, the training should be very practice-oriented. Early in the training, the teacher should be put into a situation involving children. The training should consist of instruction in the use of a variety of instructional design guides.

It has been our experience thus far in using both the tutoring instructional guide and in some of our preliminary work with the concept guide that some teachers are very happy and satisfied to use such guides and to effect the lives of children through the effective instructional design that results. Other teachers, however, begin to question the guide and to wonder if it couldn't be done another way or if there isn't some other kind of guide that could be used to accomplish some goal that the guides with which they are familiar do not accomplish. These are the people who are ideal candidates for training at the second or instructional technology level. Having become curious about the content of the guide, it's an easy next step to start to talk about the guides themselves and to help them to design new guides.

Instructional Technologist (5-6 Year MA Level)

At this level, a number of specific skills are necessary for instructional developers. These skills include training in the identification and specification of objectives, in the classification of objectives at various levels of

behavior, in techniques of empirical validation, in techniques of developmental evaluation, in techniques of test construction, in techniques of behavioral analysis, in media use including such new types of devices as CAI, student response systems, information retrieval systems, etc.

The Instructional Psychology Program at Brigham Young University attempts to provide these skills in a four semester MA program which includes courses in basic skills. These courses include measurement, with an emphasis on criterion-referenced measurement, statistics and research design at a level sufficient to provide statistical tools for developmental and validation testing, computer science and some foundation work in the psychology of learning. A proseminar-seminar series in instructional psychology emphasizes and ties together the skills required for instructional development as identified above. In addition to the coursework, students are required to serve for a minimum of three semesters as a one half-time instructional development intern.

The Instructional Development Program at Brigham Young University is designed to facilitate systematic instructional development in college courses at BYU. The program is designed to encourage faculty initiative by providing money and resources for professors to get involved in their own development. In addition, unlike many college level instructional development programs, students in the instructional psychology program are used in the actual development effort and frequently carry the whole load with faculty members serving as subject matter consultants. As a result, our students have been

responsible for developing a number of instructional units which are currently being used on the campus. These include an audio tour of the library, a self-instructional program on the card catalog, reader's guide and other library indexes, a multi-media, self-instructional program for teaching the use of the Rockwell hardness tester, an automated, self-instructional media equipment use laboratory, and other projects which are currently in progress. In all of these projects, students as interns working with faculty instructional technologists, have done the primary instructional development and have gained a great deal of training in the skills which we have specified.

As with teacher-technicians, it frequently happens that a student in the instructional technology training program starts to raise questions about the techniques that are being taught. Questions like "How do we know?" "Why don't we have principles in this area?" etc. Here again, these students become the prime candidates for our Ph. D. program in Instructional Psychology. These are the people who make excellent instructional scientists, and these are the people who have been encouraged to proceed to the instructional science level.

Instructional Scientist (Ph. D. Level)

In addition to the skills itemized for instructional technologists, an instructional scientist must have additional skills which include primarily behavioral science research techniques. These include increased training in measurement theory, philosophy of science, computer simulation, statistics, research design, and other areas which are necessary skills

for behavioral science research.

In our program at Brigham Young University, at the Ph. D. level our coursework again reflects these basic skill areas. In addition, we feel that to be an effective instructional psychologist, a student must also be, in part at least, an experimental psychologist. Considerable work in the psychology of learning and experimental psychology is also required by our program. (The program is jointly sponsored by the departments of Educational Psychology and Psychology.) In addition to the coursework, Ph. D. candidates are required to serve a minimum of four semesters as a research intern. Again, as part of the Instructional Research and Development Department, students are actively involved with our faculty in theory development and in conducting basic research on the instructional process.

SUMMARY

In 1969, I proposed that a teaching team should consist of a horizontal differentiated staff with team members trained in four distinct skill areas; (1) instructional design, (2) instructional interaction, (3) inter-personal design, and (4) inter-personal interaction.

Today, I propose in addition, a vertical differentiated staff for the new profession of instructional design. I have proposed that at the teacher level teacher-technicians be trained to use intructional design guides for guiding their instructional design efforts; that MA level or specialist level instructional technologists (engineers) be trained to develop self-contained instructional systems and instructional design guides for use by instructional technicians. At the instructional psychologist (scientist level), I have

suggested that Ph. D.'s be trained to specify and develop instructional theory and to conduct laboratory behavioral science research on principles of instruction.

REFERENCES

Glaser, R. Teaching Machines and Programed Learning II: Data and Directions. Washington D. C.: National Education Association, 1965.

Lange, P. C. Programed Instruction, 66th NSSE Yearbook, Chicago, University of Chicago Press, 1966.

Mechner, F. "Science education and behavioral technology," pp. 461-484, in Glaser, R. (editor) Teaching Machines and Programed Learning II: Data and Directions. Washington D. C.: National Education Association, 1965.

Merrill, M. D. "Teachers: technologists or technicians." The Journal of Teacher Education. 19 No. 3, Fall 1968, p. 325-330.

Merrill, M. D. Instructional Design: Readings. Englewood Cliffs, New Jersey, Prentice-Hall, Inc. 1971.

Tennyson, R. D., Woolley, F. R. & Merrill, M. D. "Exemplar and Nonexemplar Variables Which Produce Correct Concept Classification Behavior and Specified Classification Errors," Journal of Educational Psychology, 1971, in press.

INSTRUCTIONAL RESEARCH AND DEVELOPMENT WORKING PAPERS

Working Paper No.	Title, author and publisher
No. 1	Instructional Research and Development at Brigham Young University: A Statement of Philosophy and Intent, M. David Merrill & Grant V. Harrison, Department of Instructional Research & Development, Brigham Young University, 1970, unpublished manuscript.
No. 2	Faculty Guide to the Department of Instructional Research and Development, James C. Orey & Others. Department of Instructional Research & Development, Brigham Young University, 1970, unpublished manuscript.
No. 3	Organizing for Instructional System Development, M. David Merrill, Department of Instructional Research and Development, Brigham Young University, 1970, unpublished manuscript.
No. 4	Necessary Psychological Conditions for Defining Instructional Outcomes, M. David Merrill, Educational Technology, 1971, in press; Instructional Design: Readings, Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1971
No. 5	Hierarchical Models in the Development of a Theory of Instruction: A Comparison of Bloom, Gagne, and Merrill, Robert D. Tennyson & M. David Merrill, Educational Technology, 1971, in press.
No. 6	A Cybernetic Modification Scheme for an Instructional System, Michal C. Clark & M. David Merrill, Educational Technology, 1971, in press; Instructional Design: Readings, Englewood Cliffs, New Jersey: Prentice-Hall, Inc., 1971.
No. 7	Paradigms for Psychomotor Instruction, M. David Merrill, Instructional Design: Readings, Englewood Cliffs, New Jersey: Prentice-Hall, Inc. 1971.

Working Paper No.	Title, author and publisher
No. 8	Conceptual Model of Classification Behavior, F. Ross Woolley & Robert D. Tennyson, Educational Technology, 1971, in press.
No. 9	Exemplar and Nonexemplar Variables Which Produce Correct Concept Classification Behavior and Specified Classification Errors, Robert D. Tennyson & F. Ross Woolley, Journal of Educational Psychology, 1971, in press.
No. 10	The Effect of Interaction of Anxiety with Performance on Two Levels of Task Difficulty, Robert D. Tennyson, F. Ross Woolley, & Lynda J. Crosby, Journal of Educational Psychology, 1971, in press.
No. 11	A Critical Review of Experimental Methodology in Instructional Sequencing, Robert D. Tennyson, AV Communications Review, 1971, in press.
No. 12	A Quality Control Design for Validating Hierarchical Sequencing of Programmed Instruction, Robert D. Tennyson, & Richard C. Boutwell, NSPI Journal, 1971, in press.
No. 13	Instructional Objectives - Different by Design, Richard C. Boutwell & Robert D. Tennyson, Psychological Review, 1971, in press.
No. 14	Conceptual Models of Complex Cognitive Behavior, Norman B. Murray & Robert D. Tennyson, NSPI Journal, 1971, in press.
No. 15	Three Levles of Instructional Design, M. David Merrill, Department of Instructional Research & Development, Brigham Young University, presented at the American Educational Research Association convention, February, 1971.